Cars and kids: childhood perceptions of electric vehicles and transport in Denmark and the Netherlands

Article (Accepted Version)

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Abstract: What preferences, perceptions, and expectations do children have about current (and future) electric vehicles and conventional cars? The values, worldviews, and patterns of energy (and mobility) consumption that adults come to hold, and perform, become molded and perhaps cemented in childhood. However, given the particular sensitivities in conducting social science research involving children, recent comparative examinations of the perceptions and preferences of kids and cars remains rare. In this article, we offer the first international assessment of how 587 surveyed schoolchildren between 9-13 years of age across 15 schools in rural to intermediate regions in Denmark and the Netherlands think about electric mobility, and in examining their perceptions, automobility and transport more broadly. In general, we find that the children surveyed rank the environmental impact of cars just below personal safety and we can conclude that they are aware of innovations such as electric vehicles and their main benefits. Most important, children overwhelmingly seem to agree on the future direction of car-based transport but one with cars that are safer, more energy efficient and alternatively fueled.

Keywords: sustainable mobility; automobiles; environmental perceptions; values; attitudes

1. Introduction

Environmental values, preferences for particular technologies, and patterns of sustainability and natural resource consumption all begin in childhood. Various studies have shown that perceptions of the natural environment, for instance, are rooted in childhood experiences of or with nature (Chawla and Cushing 2007; Korhonen and Lappalainen 2004; Wells and Lekies 2006; Mussser and Diamond 1999). A child born into a world with plentiful electricity, or fast-moving automobiles, learns to see the world naturally as convenient and illuminated with energy (Aguirre-Bielschowsky et al. 2018), or at hundreds

of kilometres an hour (Nye 1999), becoming habituated to automobility (Urry 2004). Furthermore, early childhood encounters with various forms of transport—trains, cars, buses—are critical to the development of future mobility values and expectations (Nillson and Kuller 2000). Children also have a "tremendous capacity" for learning as well as active imaginations that could help inform the future design of environmental policy more broadly (Balmford et al. 2002). Boudet et al. (2016: 2) write that "Energy education programmes for children are hypothesized to have great potential to save energy."

Despite the significance of childhood experiences in framing future preferences for mobility, little research has systematically, or comparatively, examined schoolchildren preferences for electric vehicles in recent years. In this study, we ask: What preferences, perceptions, and expectations do children have about current (and future) electric vehicles and conventional cars? To provide an answer, we conducted a short, tailored survey among 587 children across fifteen schools in the Netherlands and Denmark aged 9 to 13, which makes it the first international comparative study on this topic, to our knowledge.

In proceeding on this path, we aim to make multiple contributions. Many youth have yet to form consistent mobility practices or reliance on the car as a driver, and thus there is great scope to influence them "before they develop their travel behavior habits" (Line et al. 2012: 270). While these children clearly will not be buying or driving a car in the near future, they are "metaphorically and literally the drivers of the future" (Kopnina 2011: 578) and their perspective on mobility is indicative of broader consumer awareness in society. Furthermore, children are recurring passengers transported every day and they are a primary group affected by transport pollution and congestion (Borg et al. 2017), in our case, across rural to intermediate regions in Denmark and the Netherlands. Lastly, we maintain it is useful for teachers, mentors and other educators to gain insight into what preconceptions (and possible misconceptions) children have concerning sustainability and transport so that they can be enhanced or corrected if possible (Leeson et al. 1997a).

The article proceeds as follows. It first defines electric vehicles and then seeks to justify a focus on them given their potential environmental and health benefits. It then offers a brief review of the literature on children and perceptions of mobility and transport (emphasizing five themes) before explaining the study's research design. It lastly presents its results and discussion, organized inductively among four dimensions: (1) the popularity of car ownership, (2) knowledge about electric mobility, (3) the desirability of private vehicles, and (4) innovations in future mobility.

2. Conceptualizing Electric Vehicles and Sustainability

The core focus of our study is on electric vehicles, a term meant to encompass any passenger vehicle that uses energy drawn from the electric grid and stores it on board for propulsion (She et al. 2017). To those familiar with the literature, our definition thus includes battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), fuel-cell electric vehicles (FCEVs) and range extended electric vehicles (REEVs) (Schneidereit et al. 2015). We use the term EVs colloquially to refer to all of these different technical categories of vehicle type and model.

We selected EVs as the focal point for the study because such innovations do hold significant potential for positive environmental performance and beneficial impacts on health compared to conventional cars, because EVs are cleaner, more efficient and a technology open to alternative more sustainably generated power (Buekers et al. 2014). The average petroleum-powered vehicle emits about 20 pounds (9.1 kilograms) of carbon dioxide per gallon of gasoline burned, making the transportations sector responsible for about one-quarter of greenhouse gas emissions in the United States and Europe and one-sixth of global emissions (Intergovernmental Panel on Climate Change 2014; Tran et al. 2012). Conventional automobiles are also the largest single human-caused source of particulate matter (PM) in many countries, and for those with stringent emissions requirements for vehicles such as California or

the European Union the second largest human source after power plants. Numerous medical studies have strongly associated inhalation of PM with heart disease, cardiopulmonary disease, atherosclerosis development, cystic fibrosis, chronic lung disease, and some forms of cancer (National Center for Envirnmental Assessment 2006; Pope et al. 2009).

In support of the social and environmental credentials of EVs, many drivers suggest they prefer them because they offer the potential to reduce tailpipe pollution and to curtail greenhouse gas emissions (Axsen 2013; Axsen et al. 2016; Carley et al. 2013; Egbue and Long 2012); although this can depend on the type of vehicle and the carbon intensity of the electricity used to recharge the batteries (Ellingsen et al. 2016). Even with those caveats, Addison et al. (2010) estimate that EVs can reduce carbon dioxide emissions by 62 to 65% compared to internal combustion vehicles. Hence, the International Energy Agency (2010) suggests that to stabilize CO_2 concentrations at 450 ppm, 40% of new vehicle sales globally must be plug-in electric by 2040, with most remaining vehicles fuelled by biofuels. Furthermore, others have shown that electric vehicle drivers learn to become more sustainable in other aspects of their life beyond transport, such as coming to learn more about reducing waste or advocating renewable electricity for the home, being no longer trapped in "technological unconsciousness" (Ryghaug and Toftaker 2014).

However, the environmental and positive social contributions of EVs are not a forgone conclusion. Experts on mobility have suggested that when EVs are encouraged alongside other modes such as walking, cycling, ridesharing and inter-modality (Kester et al. 2018), they can further reduce emissions (beyond just electrification) as well as space use; while EV-use in mobility systems that encourage private, individual driving (especially as a second or third car) can have negative impacts on sustainability (Sovacool 2017). In parallel, when EVs are used in cities or countries with low-carbon electricity, they can benefit the environment, but when used in those that rely on fossil fuels, those gains

in carbon dioxide reduction are mitigated. Moreover, as private cars, EVs run the risk of further embedding motorized, private automobility as well as increased driving. These tensions over sustainability are particularly reflected in the literature on "rebound effects" and transport (Greening et al. 2000). As Isenhour (2010: 459) writes, "even though cars may be more efficient, drivers often rationalize driving more often and farther because of these fuel-efficiencies, offsetting gains. The increasing affordability of energy efficient vehicles also drives demand for the resource extensive production of new cars, regardless of the functionality of existing automobiles or the absence of plans for their further use or safe disposal." Graham-Rowe et al. (2012) noted for example that because adopters perceived their EVs to be more "environmentally-friendly," they drove them 1.64 times further than cars they did not see as "eco-cars." Some PHEV drivers in the United Kingdom even attempted to recharge their vehicles not by plugging in at home or at work, but by running the internal combustion engine and then using the re-generative braking system to "charge" their vehicle—"thereby negating the carbon savings" (Graham-Rowe et al. 2012). Similar "rebounds" have also occurred in EV driving in Austria (Seebauer 2018) and Sweden (Langbroek et al. 2018). Modelling of EV driving behaviour in South Korea also underscores this paradox (Hamamoto 2019): EVs are more technically efficient than conventional cars, meaning they have great carbon abatement potential, but if/when adopters increase their annual mileage, overall emissions for transport can actually increase. This underscores that EVs can entrench automobility. Indeed, Table 1 summarizes the different dimensions by which EVs can promote sustainability or erode it.

Table 1: Positive and negative impacts of EVs and Sustainability

Dimension	**Positive impacts**	**Negative impacts**

Intermodality	EVs are used in combination with cycling, walking, or mass transit, and reduce overall car usage	Use of EV in systems that encourage excessive driving and EVs as second or third (luxury) cars, displaces enthusiasm for cycling
Automobility	Substitution of cars and scooters	Increase in car-based mobility
Organized car sharing	Use of EVs in car sharing/ride sharing schemes	Increase in preferences for private, single-occupancy driving practices
Electricity supply	Use of EV in countries with de-carbonized electricity grids	Use of EV in countries with coal-based electricity
Smart grids	Charging at off-peak times and storage for peak demand	Charging at peak times with no storage
Lifecycle externalities	Efficient manufacturing techniques with an appreciation for externalities with battery recycling	Inefficient and polluting manufacturing techniques with no battery recycling
Employment, competitiveness, and growth	Designed and promoted by sustainable firms with a focus on innovation and entrepreneurship	Co-opted and marginalized by transnational conglomerates with little desire for social change

Source: Modified from Sovacool (2017).

Consequently, the desirability and sustainability of EVs will depend on context. For example, in contrast to the above studies based on EV test projects, data from Norway, the country with world leading EV market and fleet shares, shows slightly different daily travel patterns but similar yearly mileages when one compares BEV drivers with actual comparative subsamples of multiple car households and new car buyers (Figenbaum 2018). It is with similar appreciation for nuance that we sought to elicit the perceptions of what children in two European countries, Denmark and the Netherlands, thought about them.

3. Cars and Kids: A brief review

In proceeding on this path of illuminating what kids think about cars, this study fills a small but slowly growing literature crossing transportation, mobility, educational, and environmental research. Although far from an exhaustive review, our own assessment of the literature has discerned five interrelated themes: school transport (including active travel), car travel patterns and preferences, environmental awareness and attitudes, learning to drive and transitions to adulthood, and attempting to depict children's behavior as future adults.

3.1 School transport and active travel

The first and perhaps most established theme has been children's travel to and from school, a subject of research dating back to at least the 1970s. A sample of recent work in Europe has emphasized for example that complex sociodemographic, attitudinal, and environmental factors will all influence whether children from different age groups drive to school, take a bus, walk, or commute another way. Schneiner et al. (2019) examine these dimensions related to children's school trips in Germany and find that the attributes of a mother's preference affect travel patterns and perceptions more than the father's attributes; and that the probability of walking and cycling increases with age. Konrad and Wittowsky (2018) looked at the extent that computers or "virtual travel" (such a telecommuting) could offset physical trips to school in Germany, and noted it does not seem to substitute strongly for physical mobility.

Helbich et al. (2016) similarly assessed active transport modes to school (namely walking and cycling) in a sample of Dutch children aged 6 to 11 years old, tracking 623 trips with a GPS system. They concluded that well-connected streets and cycling lanes have a strong positive association with active transport to school, but that neither green space nor weather was significant. Kaplan et al. (2016)

also explored active transport to school in Denmark, and noted that policy changes such as lessening the amount and the density of car and truck traffic, and fewer motor vehicle accidents, would increase the probability that 10 to 15 year olds would travel to school actively.

Outside of Europe, Carver et al. (2013) note that in Australia the probability of a child taking a private car to school increases when at least one parent is not employed full time, and that some parents even come to welcome car trips as quality time being spent with their children. Stone et al. (2014) and McDonald and Aalborg (2009) find that in the United States, and Fusco et al. (2012) in Canada, that driving to school is perceived as superior to both bus and active travel because it is seen as faster, safer, and more convenient.

3.2 Car travel patterns, preferences and experiences

The next theme investigates more general patterns, preferences, and experiences between children and cars (sometimes compared to other forms of transport). In Europe, for instance, Kopnina (2011) examined children's attitudes in relation to cars in the Netherlands, talking to both children aged 10 and 11 years old as well as their parents. They found a strong preference for cars over bicycles, and noted that more than 70% of the households owned a car themselves. After the children wrote an essay about cars, Kopnina (2011) analysed the results and found that many wrote about "positive experiences" with cars as well as "positive attitudes" about conventional cars. These positive notions are rooted in feelings of pride, safety, and enjoyment (such as "I like mum driving me" or "driving is fun"). Negative experiences and attitudes did exist, such as "cars are dangerous because of accidents" and "cars are bad for nature," but these were far less frequent.

In follow up work, Kopnina and Williams (2012) surveyed 140 upper elementary school children in one city in the Netherlands, and discovered "remarkable" differences in preferences for cars between

schools. They reported that 23 percent of children in one school said they wanted to own a car, but that this was 80 percent in another school. Kopnina and Williams (2012) also discovered a paradox; that while attitudes and behaviour may not always be consistent, the poor did not own cars but wanted to, and the wealthy owned cars but seemed to not to want to use them. As they concluded: "Children of a lower socio-economic status exhibit more positive attitudes towards cars than their more economically privileged peers. This preference for cars is likely to be related to the children's idea of social status" (Kopnina and Williams 2012: 124).

Line et al. (2010, 2012) conducted focus groups with young people aged 11 to 18 years old in the United Kingdom. They noted that the travel behaviour of children and young adults was "dominated by a desire to drive," and that it was also strongly grounded in values relating to "identity, self-image, and social recognition (at the expense of their environmental values)" (Line 2010: 238). This preference for driving was independent of the specific age of the children, cutting across secondary school (age 11), college and sixth form (age 15), and higher education (age 18). In sum: "all of the participants stated their intention to learn to drive, or continue driving, in the future … In contrast, the participants referred to the lack of speed they believe is associated with the bus and the time-pressure they feel as a result" (Line 2010: 239). Sigurdardottir et al. (2014) interviewed fifty 15 year olds in Denmark and found a more diverse range of reactions. Some within the group were "car enthusiasts," associating cars with high values and a car-oriented lifestyle. Others however were "car pragmatists," expressing a more ambivalent view of cars, with a third group of "car sceptics" who had low to no interest in cars and imagined a cycling oriented lifestyle.

Lastly, Boudet et al. (2016) suggest that such autocentric transport preferences can be difficult to alter, as transport is harder to decarbonize than other areas (such as electricity). The reason here is that such values and preferences for mobility, at least in the United States, are "difficult to change because

they are particularly constrained by geographic, cultural and economic factors, especially for young children who likely have little control in these domains" (Boudet et al. 2016: 5).

3.3 Environmental awareness and attitudes

A third theme—sometimes expressed as a subset within the earlier themes looking at (1) school transport or (b) car patterns and preferences—concerns the environmental awareness and attitudes of children. Here the evidence is perhaps more nuanced and complex.

In their survey of pupils in the United Kingdom, Boyes and Stanisstreet (1997) documented that many children hold false views about the environmental consequences of driving. They noted that 83% of those taking their survey confused ozone depletion (caused by chlorofluorocarbons present in things like refrigerators or air conditioners) with automobiles (which generally cause ambient air pollution and contribute to climate change but not ozone depletion). Egbue et al. (2015) designed a series of workshops with seventh and eighth grade girls in the United States, and noted how before the workshops many participants had "little or vague" knowledge about the environmental impact of transportation or the specifics of electric vehicles. This finding sits in line with earlier work on childhood perceptions indicating that students could not successfully identify natural wildlife such as the names of birds, plants, or mammals (Balmford et al. 2002). Complicating factors, Boyes and Stanisstreet (1997) note that transport and mobility, and even environmental sustainability more generally, are not often formal test subjects in school. As they caution, "unlike the classroom setting, children cannot test their interpretations of the given information against those of their teachers, so erroneous interpretations may go unchallenged" (Boyes and Stanisstreet 1997: 270).

Batterham et al. (1996) however give contrasting evidence. They conducted a survey among students in the British National Curriculum Years 7 (age 11 to 12 years), 9 (age 13 to 14) and 11 (age 15

to 16), and found that a "majority of children did correctly identify cars as a major cause of environmental problems," especially vehicle emissions related to exhaust, fumes, smoke, and gas. Leeson et al. (1997a) distributed a survey to 165 children in the United Kingdom from six teaching groups in National Curriculum Year 6, and found strong knowledge about EVs and fuel-efficient cars. They noted that more than three-quarters of children realized that battery powered EVs reduced pollution, and that they correctly stated that the fuel economy of a vehicle was beneficial to the natural environment. Perhaps surprisingly, about half of the children even appreciated that well maintained engines polluted less. As Leeson et al. (1997a: 13) concluded: "children do not need persuading that vehicles and their emissions pose an environmental threat, or indeed that the 'environment' is important."

Using a more recent sample of focus groups with young people in the United Kingdom aged 11 to 18 years old, Line et al. (2012) report a more complicated view that children and young adults connect *some* environmental problems with cars, such as particulate matter and air pollution. However, they have difficulty with more complex and remote phenomena such as climate change. As they write, "with respect to the timescale of climate change, several participants suggested that their concern about issues in the present, such as exams and homework, takes precedence over that in relation to the likely impacts of climate change in the future" (Line et al. 2012: 243). This finding was also supported by follow-up work from Leeson et al. (1997b), who noted that children in the United Kingdom acknowledged some of the environmental impacts of cars (such as traffic jams, air pollution emissions) but had difficulty with more abstract environmental problems such as climate change or ozone depletion.

3.4 Learning to drive and transitions to adulthood

A fourth stream of research, admittedly less prominent but still salient, examines learning to drive and the experiences of young adults preparing for their driver's license. Fylan et al. (2018) explore the

motivations and expectations of young people about learning to drive in the United Kingdom. They conducted 12 focus groups with 48 young people aged 16 to 24. They noted that many young people believe driving provides independence and represents an important point of maturation as they transition into becoming an adult. The car is also seen as mechanism for enhanced personal freedom and control (especially when it comes to driving to get food, beginning a job or starting a career, or going on romantic dates), and for bestowing status, particularly for those who are the first in their group of peers to pass their driving test and get their license.

Davison et al. (2003) also notice this theme of temporality between youth and adults. They discuss how young people in Scotland often begin as dependent passengers of public transport when they view mobility merely as "fun," often traveling on buses and trains. However, over time, this view of "fun" dissipates and they come to appreciate the importance of freedom and independence, with public transport use dropping significantly after age 13, when independent travel with friends becomes more commonplace. It is also in this latter group of young adults where aspiration for car ownership and use is the highest.

3.5 Predicting future adult behavior

A fifth and final theme concerns predicting how children might behave when they become adults. Admittedly, some of the themes above do this implicitly (asking about things like values, attitudes, or preferences and then interpreting results), but in this theme we put work that does it explicitly.

For example, Sigurdardottir et al. (2013) overtly asked 15-year-old children to think about what they would do as adults when it came to traveling by car or bicycle in Denmark. They found that more than 80% of young adults stated they intended to learn to drive and own a personal car. Other research has sought to explain why car use continues to decline in some industrialised countries, a phenomenon

known to some as “peak car” (Bergman et al. 2017). Kuhnimhof et al. (2012) for instance examined travel patterns and trends by young adults in Germany and then explicitly extrapolated their travel trends into future scenarios about car use as adults.

3.6 Research questions

In this particular study, we endeavored to provide a recent, comprehensive, larger and comparative survey of childhood perceptions of transport and mobility. Our central question is: What preferences, perceptions, and expectations do children have about current (and future) electric vehicles and conventional cars? Our specific contribution is investigating car perceptions in a quantitative way addressing the younger age group of 9-13 with a relatively large - albeit convenient - sample size. Our study thus attempts to bridge between transport research, which focusses on the consequences of cars, the motives for having them, and the impact of automobiles on social life, and research around environmental education, which focusses on how to change children’s attitudes towards the environment as well as measure the current knowledge of different age groups.

4. Research Design

To investigate the preferences and expectations of children about cars in general, we designed and then distributed a survey of 10 questions (see the Supplementary Online Material) to a target group of children between 9 and 13 years old (due to class compositions) in both the Netherlands and Denmark through their respective elementary schools. After collecting demographic information about respondents, this instrument asked questions such as “What is your favorite car,” “What is most important about a car,” “How much do you think cars cost,” and “In the future, what forms of mobility should we adopt?”

4.1 Sampling

We would classify our sample as a purposive convenience sample aimed at a random range of schools - excluding special needs education – within rural to intermediate regions in Denmark and the Netherlands. Within the schools, the sample focused on children in Dutch school groups 7 and 8 and Danish school groups 4 and 5, which primarily equates to children between 10 and 12 years old, but also includes some 9 and 13-year olds. Our sampling frame or procedure was schools—we initially contacted 79 schools through their directors, principals, and headmasters/headmistresses. Fifteen agreed to distribute our questionnaire to students (11 in the Netherlands, four in Denmark), with permission granted by both the directors and the teachers. In both countries, the schools were primarily situated in rural or intermediate regions (Eurostat classification) in small to medium sized towns or city neighbourhoods (See Figure 1) across Overijssel and Friesland in the Netherlands and Midtjylland in Denmark.

Figure 1: Location of Fifteen Schools Participating in our EV Study

Source: Authors. Graphics designed from Open Street Map.

As such, the children are not representative of all children in both countries, but the study does offer an attempt to move beyond the urban focus in the studies above and the traditionally white, often older, more highly educated homeowners that permeate EV surveys and choice experiments (Bailey and Axsen, 2015). However, because such regions have less public transport options, now and in the near future, a consequence is that the children can be assumed to be more car focused. For the Netherlands, we relied on the professional network of a co-author, whom used to work as a secondary school teacher there. For Denmark, we contacted a similar number of schools as the Netherlands by generating a list within driving distance of our home base by mail and phone.

After a positive response from the director and teacher, a date was set for a personal visited and, if so requested, a letter sent to the parents explaining the research and data requirements (e.g. gender and age). During the visit, the children were handed a translated paper version of the survey and offered a brief, nonspecific introduction about the procedure and background of the study stressing that it was voluntary, that names were not necessary and that the survey was not a test. The survey taker, a certified primary school teacher with a master in education studies, remained available to clarify the survey and answer more specific questions about electric cars after all the children handed in the survey. On average, these visits lasted about 20 to 30 minutes per class. After receiving the surveys, each pupil was given an individual respondent number and the answers where entered into a database for further analysis.

Given the young age of the recipients, and on advice of our co-author, we tried to keep the language as simple and neutral as possible, while minimizing suggestive phrasing and shifting popular answers to the bottom of the ranking questions in order to counter the "primacy effect": that children pick the first things they read (Bell 2007). Another aspect considered was the "pleasing" or "satisfying" strategy, which especially applies to children in studies with a clear favorable option (Borgers et al. 2003). We countered this partly by asking about cars and transport in general and by clearly separating positive and negative aspects. We also asked the children to rank their answers in three of the 10 questions. We decided not to add a combination of questions to keep the paper survey as short as possible. Given these decisions, the response rate was quite high with only a handful of incomplete surveys.

In the end, 587 children completed the survey successfully across 15 schools (aged 9 to 13 years, with a median of 11 years of age). As Table 2 indicates, 382 came from 11 schools in the Netherlands and 205 from four schools in Denmark. In general, the distribution of charter schools is equal between the countries with 205 students in both Denmark and the Netherlands, while another 177 attended public

schools in the Netherlands. School size ranged from very small schools with 50 pupils in the Netherlands up to schools with as many as 645 pupils. In terms of gender, the survey is also balanced with 292 girls and 295 boys.

Table 2: Demographics of the Survey Sample (n=587)

		Country		Gender		Age				
		Netherlands	Denmark	Female	Male	9	10	11	12	13
Country	Netherlands	382		186	196	7	90	185	93	7
		100.0%		48.7%	51.3%	1.8%	23.6%	48.4%	24.3%	1.8%
	Denmark		205	106	99	7	58	96	42	2
			100.0%	51.7%	48.3%	3.4%	28.3%	46.8%	20.5%	1.0%
Gender	Girl	186	106	292		3	79	150	58	2
		63.7%	36.3%	100.0%		1.0%	27.1%	51.4%	19.9%	0.7%
	Boy	196	99		295	11	69	131	77	7
		66.4%	33.6%		100.0%	3.7%	23.4%	44.4%	26.1%	2.4%
School Type	Public School	177		80	97	1	47	81	44	4
		100.0%		45.2%	54.8%	0.6%	26.6%	45.8%	24.9%	2.3%
	Charter School	205	205	212	198	13	101	200	91	5
		50.0%	50.0%	51.7%	48.3%	3.2%	24.6%	48.8%	22.2%	1.2%
School Size	Small (0 to 125)	120		50	70	1	31	56	31	1
		100.0%		41.7%	58.3%	0.8%	25.8%	46.7%	25.8%	0.8%
	Medium (126 to 250)	89	116	95	110	7	52	93	49	4
		43.4%	56.6%	46.3%	53.7%	3.4%	25.4%	45.4%	23.9%	2.0%
	Large (>250)	173	89	147	115	6	65	132	55	4
		66.0%	34.0%	56.1%	43.9%	2.3%	24.8%	50.4%	21.0%	1.5%
# of cars in household	0	3		2	1			1	2	
		100,0%		66,7%	33,3%			33,3%	66,7%	
	1	105	68	82	91	6	52	71	41	3
		60,7%	39,3%	47,4%	52,6%	3,5%	30,1%	41,0%	23,7%	1,7%
	2	225	113	171	167	6	84	165	80	3
		66,6%	33,4%	50,6%	49,4%	1,8%	24,9%	48,8%	23,7%	0,9%
	3	35	15	27	23	2	11	29	7	1
		70,0%	30,0%	54,0%	46,0%	4,0%	22,0%	58,0%	14,0%	2,0%
	>4	14	9	10	13		1	15	5	2
		60,9%	39,1%	43,5%	56,5%		4,3%	65,2%	21,7%	8,7%

Source: Authors

4.2 Method and data analysis

Given the purposive convenience sampling towards schoolchildren in rural to intermediate regions, the survey is not representative of all children in Denmark and the Netherlands. Furthermore, the simplified and short survey inhibits potential analyses, especially due to the use of ranking questions.

Hence, the nominal and ordinal data is analyzed with descriptive statistics and nonparametric Chi-square, Mann-Whitney U and K-Independent Kruskal Wallis tests.

In terms of variables, we draw on a number of demographic independent variables. Country, as this to us represents regional and national context, including taxation levels, EV availability, incentives, media discourse, and parental discussions – as well as different habits around grading. School size, as representative of local levels of urbanization given that schools become smaller with smaller communities. School type, as an indicator of socio-economic status. For even though most of the schools find themselves in lower socio-economic environments, there are slight variations which we try to capture through the difference between public and charter schools. In particular, we see the added parental contribution in terms of money and time to charter schools for a particular form of education (inspired on religion, alternative teaching concepts, focus areas), as an indirect indicator of higher socioeconomic status. We further separate those pupils who say they have seen an EV (EV Observation) from those who claim to have experienced travelling in an EV (EV Experience).

5. Results and Discussion

As Table 3 summarizes, the survey results gave us plenty to consider. Here, we focus on four key dimensions of our findings: car ownership, brands, and cost; electric mobility; the desirability of private vehicles; and perceptions about future innovations.

Table 3: Statistical Summary of Survey Responses and Demographic and Contextual Attributes

Questions			Country		Gender		Age	School	# of cars	School Size			School Type		EV Observation		EV Experience	
		Count or Mean	Netherlands	Denmark	Girl	Boy	Count or Mean	Count or Mean	Count or Mean	Small (0 to 125)	Medium (126 to 250)	Large (>250)	Public	Charter	Observed an EV	No observation	No Experience	Experience with EV
Have you ever seen or travelled in an Electric Vehicle?*	Don't Know	76	43	33	52	24	76[a]	76	76[a]	14	30	32	21	55	0	76	76	0
	No	43	24	19	24	19	43	43	43	15	15	13	18	25	0	43	43	0
	Yes, seen	275	202	73	126	149	275	275	275	69	89	117	97	178	275	0	275	0
	Yes, travelled	148	89	59	63	85	148	148	148	19	53	76	34	114	148	0	0	148
	Parents have one	45	24	21	27	18	45	45	45	3	18	24	7	38	45	0	0	45
	Obs.	469	316	153	216	253	469[a]	469	469[a]	91	161	217	139	330	469	0	276	193
	No Obs.	118	66	52	76	42	118[a]	118	118[a]	29	44	45	38	80	0	118	118	0
	No Exp.	394	269	125	202	192	394[a]	394	394	98	134	162	136	258	275	118	394	0
	Exp.	193	113	80	90	103	193[a]	193	193	22	71	100	41	152	193	0	0	193
Which car is best for the environment?*	Incorrect	15	12	3	10	5	15	15	15	5	1	9	4	11	12	3	10	5
	Correct	572	370	202	282	290	572	572	572	115	204	253	173	399	457	115	384	188
Which car accelerates faster?*	Incorrect	362	249	113	177	185	362	362	362	86	117	159	120	242	278	84	257	105
	Correct	225	133	92	115	110	225	225	225	34	88	103	57	168	191	34	137	88
Which car makes the least amount of noise?*	Incorrect	39	18	21	33	6	39	39	39	10	9	20	8	31	22	17	29	10
	Correct	548	364	184	259	289	548	548	548	110	196	242	169	379	447	101	365	183
Which car has the longest range?*	Incorrect	169	89	80	109	60	169	169	169	29	71	69	44	125	125	44	110	59
	Correct	418	293	125	183	235	418	418	418	91	134	193	133	285	344	74	284	134
Which car is cheaper to drive?*	Incorrect	284	184	100	153	131	284	284	284	63	89	132	76	208	225	59	192	92
	Correct	303	198	105	139	164	303	303	303	57	116	130	101	202	244	59	202	101
Which car is quickest to fill after it is empty?*	Incorrect	101	65	36	56	45	101	101[a]	101	27	33	41	34	67	68	33	75	26
	Correct	486	317	169	236	250	486	486[a]	486	93	172	221	143	343	401	85	319	167

What is most important about a car?**	Nice looking	3.7	3.44	4.18	3.54	3.86	3.7	3.7	3.7	3.51	3.82	3.69	3.52	3.78	3.78	3.39	3.64	3.82
	Can go fast	3.67	3.35	4.26	3.39	3.94	3.67	3.67	3.67	3.41	3.95	3.56	3.49	3.74	3.72	3.46	3.56	3.89
	Go where you want	4.19	4.28	4.02	4.3	4.08	4.19	4.19	4.19	4.37	4.17	4.13	4.33	4.13	4.16	4.31	4.23	4.11
	Feel like home	2.86	3	2.6	2.88	2.84	2.86	2.86	2.86	2.95	2.59	3.03	2.75	2.91	2.86	2.85	2.88	2.81
	Safe	4.62	5.13	3.68	4.83	4.41	4.62	4.62	4.62	4.95	4.32	4.71	5.06	4.43	4.57	4.85	4.75	4.36
	Silent	1.96	1.81	2.25	2.05	1.87	1.96	1.96	1.96	1.83	2.16	1.87	1.86	2	1.92	2.14	1.94	2.01
What is the most important downside of cars?**	Dangerous	4.56	4.57	4.54	4.73	4.39	4.56	4.56	4.56	4.59	4.64	4.48	4.54	4.57	4.5	4.8	4.61	4.47
	Noise and Smell	3.22	3.25	3.17	3.36	3.09	3.22	3.22	3.22	2.98	3.46	3.15	3.32	3.18	3.16	3.46	3.25	3.16
	Takes lots of Space	2.64	2.45	3.01	2.54	2.75	2.64	2.64	2.64	2.45	2.61	2.76	2.42	2.74	2.73	2.31	2.6	2.73
	Environmental impact	4.66	4.74	4.5	4.68	4.64	4.66	4.66	4.66	4.78	4.69	4.58	4.85	4.57	4.64	4.72	4.71	4.56
	Motion sickness	3.23	3.18	3.32	3.18	3.27	3.23	3.23	3.23	3.3	3.13	3.27	3.15	3.26	3.17	3.43	3.16	3.36
	Showing off/Status symbol	2.7	2.82	2.46	2.53	2.86	2.7	2.7	2.7	2.9	2.48	2.77	2.74	2.68	2.81	2.25	2.67	2.75
In the future, we should...?***	Drive less and take more public transport	0.31	0.26	0.4	0.38	0.25	0.31	0.31	0.31	0.34	0.4	0.23	0.33	0.3	0.26	0.51	0.36	0.22
	Make cars more energy efficient	1.49	1.74	1.03	1.44	1.54	1.49	1.49	1.49	1.82	1.36	1.45	1.85	1.34	1.55	1.25	1.42	1.64
	Build more and larger cars	0.48	0.52	0.4	0.45	0.51	0.48	0.48	0.48	0.43	0.39	0.56	0.47	0.48	0.53	0.25	0.45	0.53
	Shift cars to other fuels	1.16	1.05	1.34	0.96	1.35	1.16	1.16	1.16	1.06	1.19	1.17	1.04	1.2	1.18	1.05	1.07	1.33
	Build safer cars to survive accidents	1.68	1.59	1.84	1.83	1.53	1.68	1.68	1.68	1.5	1.63	1.79	1.43	1.79	1.63	1.88	1.73	1.58
	Build more roads and parking space	0.35	0.36	0.33	0.38	0.32	0.35	0.35	0.35	0.3	0.36	0.37	0.28	0.38	0.35	0.35	0.4	0.26

	Make more areas prohibited for cars	0.39	0.33	0.51	0.46	0.32	0.39	0.39	0.39	0.35	0.48	0.34	0.37	0.4	0.36	0.51	0.42	0.33
	Make cars more expensive	0.14	0.15	0.13	0.11	0.18	0.14	0.14	0.14	0.2	0.19	0.08	0.22	0.11	0.13	0.2	0.16	0.11

Notes:
Colors indicate significance at $p < .05$ and $p < .005$ level
* Chi-Square test
** Max mean = 6, with K-Independent Kruskal-Wallis Tests for Age; School; School Size; and # of Cars in Household. All others Mann-Whitney U tests.
*** Max mean = 3, with K-Independent Kruskal-Wallis Tests for Age; School; School Size; and # of Cars in Household. All others Mann-Whitney U tests.
[a] Chi-square results significant, but most likely invalid due to <20% or less than 1.

Source: Authors

5.1 The popularity of car ownership, branding, and costs of a car

Despite fairly recent innovations in things like ride sharing or business models such as Uber, the literature in section 3 highlighted that most children still want to own (in a classic sense) a car. Our survey confirms this finding, with a resounding 96.6% of children across our sample affirming their desire to one day own a car. In fact, only one pupil rejected it outright and a mere 19 claimed to be unsure. This is perhaps unsurprising as 99.5% of the children in our sample reported having at least one car in their household, to a 1.89 ratio of car ownership among our sample. This reflects only 3 kids in a carless household, 173 one-car households, 338 two-car households, 50 in a three-car household, and 23 kids with more cars after that.

Although earlier work suggested children have difficulty identifying species of animals (Balmford et al. 2002) or the causes of ozone depletion (Batterham et al. 1996), they certainly can successfully identify popular automotive brands. When asked about their favorite car, sports cars absolutely ranked high (from Chevrolet Corvettes to custom-made Koenisgsegg's) although one pupil really set his hopes on a "flying car." Across the sample, the most popular brand was BMW (12.4% and excluding Mini Coopers), followed by Lamborghini, Audi, Ferrari, and Porsche. Interestingly, more than 30 children (5.1%) mentioned Tesla as their favorite car.

Many children do not express these preferences lightly—they seem to have a roughly accurate sense of how much cars cost. Excluding a few outliers (some of the sample thought a car cost more than €1.5 million), a sub-sample of respondents (N=571) estimated a mean price of 35,996 euros for a conventional internal combustion vehicle (*SD* = 73,253 and *SEM* = 3066) and 78,040 euros for an electric vehicle (*SD* = 149,718 and *SEM* = 6265). Danish children offer a higher mean price estimate for cars – in line with higher car prices in that country.

A Spearman's rank-order correlation further shows a reasonably but significant correlation between these two variables, $r_s(571) = .624$, $p < .001$, indicating that children systematically estimate higher prices for electric vehicles than conventional cars. Furthermore, even though a one-sample Wilcoxon signed rank test shows a significant difference for the observed ranks and a median of 13,423 euro, Z = 90, 545, $p = .024$ to the real-life average combined Dutch and Danish price difference of 15,221 euro, the median from the children is not that far off money wise. The median difference that the pupils estimate comes close to the actual difference between a petrol and EV car (as given by Volkswagen Golf prices), especially if we further curtail the outliers. In other words, our survey indicates that, even though the children have a wide variety of costs estimates, the average and median estimated prices come fairly close to actual market prices for a decent size family car.

5.2 Electric mobility knowledge and experience

The children within our sample seem to recognize—and appreciate—many of the (more complex) benefits of electric vehicles. For instance, unlike the findings from Egbue et al. (2015) reporting little knowledge of EVs among young girls, our pupils had no trouble identifying electric vehicles as "environmental friendly" (97.4%) and "quieter" (93.4%), thus rejecting some of the skepticism in the environmental literature discussed in section 3.3 (Sovacool and Blyth 2015). Moreover, 71.2% properly answered that EVs on average have a more limited range compared to conventional cars, and 82.8 percent correctly answered that electric charging takes longer than filling an ICE vehicle, questions many adults get wrong, see Axsen et al. (2017) for more on consumer misperceptions of EVs. To be clear, our emphasis here is on *comparative* range, to conventional cars, not that EVs cannot meet the mobility needs of many in Europe, which they can For example, Liu et al. (2015) estimate that 64% of the vehicles in

Denmark drive less than 40 kilometer per day, meaning existing EVs are sufficient to meet these travel patterns.

The repeated Pearson Chi-square test in Table 3 (above) showed few significant associations between these answers by country (acceleration, noise and range), gender (noise and range), school type and size (acceleration), or across the schools (range). Range in particular was estimated correctly by more Dutch pupils and by boys, although surprisingly the boys did not answer significantly differently as the girls when it comes to acceleration. Most importantly, however, the survey confirms that children who have observed EVs answer four of these questions significantly better than those who have never seen them. Stated EV experience among children in contrast is only related to acceleration – an embodied experience – but does not add to a substantially higher EV score: No observation (*M*=3,97, *SD*=1,12), Observation (*M*=4,44, *SD*=,96), and EV experience (*M*=4,46, *SD*=1,0).

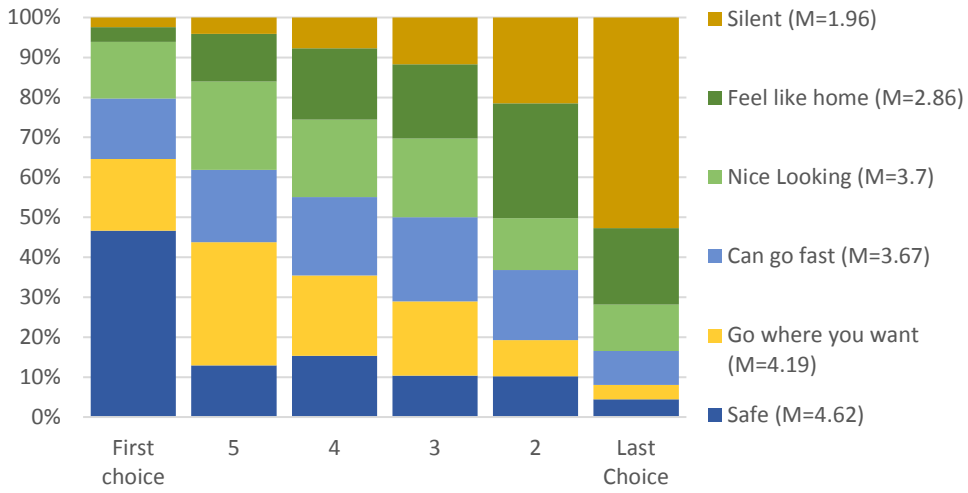
That said, children across the board exhibit less knowledge about the variable costs of electric vehicle ownership and features such as more rapid acceleration. Also, the survey indicates that experience with an EV is related to the schools and their size and type, indirectly pointing to the socioeconomic status of the children's region, given that larger schools are situated in more urbanized regions. Our results further show significance between countries when it comes to EV experience, with relatively more Danish students indicating they have ridden in an electric vehicle firsthand—which is odd given that per capita adoption rates are higher in the Netherlands than in Denmark (International Energy Agency 2016).

5.3 The desirability of private vehicles

The children surveyed expressed a striking and strong preference for motorized, privately owned, individually driven transport. In other words, the core values and concerns of automobility (Urry 2004) rank high, as children appreciate the safety, freedom, and status that privately owned automobiles

convey. More than 500 pupils in the sample (85.2%) indicated that safety, freedom, and/or status were the most important factors when considering an automobile—as Figure 2 summates.

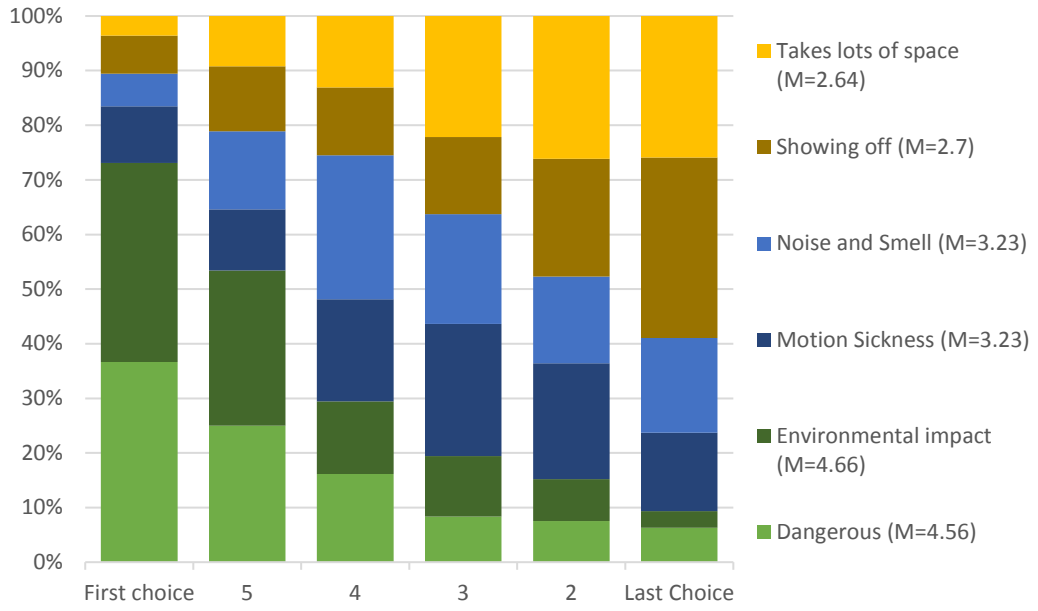
Figure 2: Children's perceptions of the advantages of cars (first choice = 6 points)



Source: Authors. Note: Figure shows the results as a percentage of all responses, while the mean score for each item is given in the legend.

Nevertheless, children also identified the danger that cars pose to pedestrians and others (with multiple pupils afterwards asking about the absence of noise) and their environmental impact as primary and poignant disadvantages of a car, as Figure 3 illustrates. Given that we are dealing with children, these notions were followed by disadvantages that they experience physically: motion sickness and the noise and smell from cars. The low score for the space and parking requirements of cars – a core problem in urban environments – reflects their rural or intermediate region and begets an unawareness of a challenge gaining prevalence among city and transport planners (Geels et al. 2012; Mitchell et al. 2010).

Figure 3: Children's perceptions of the disadvantages of cars (first choice = 6 points)



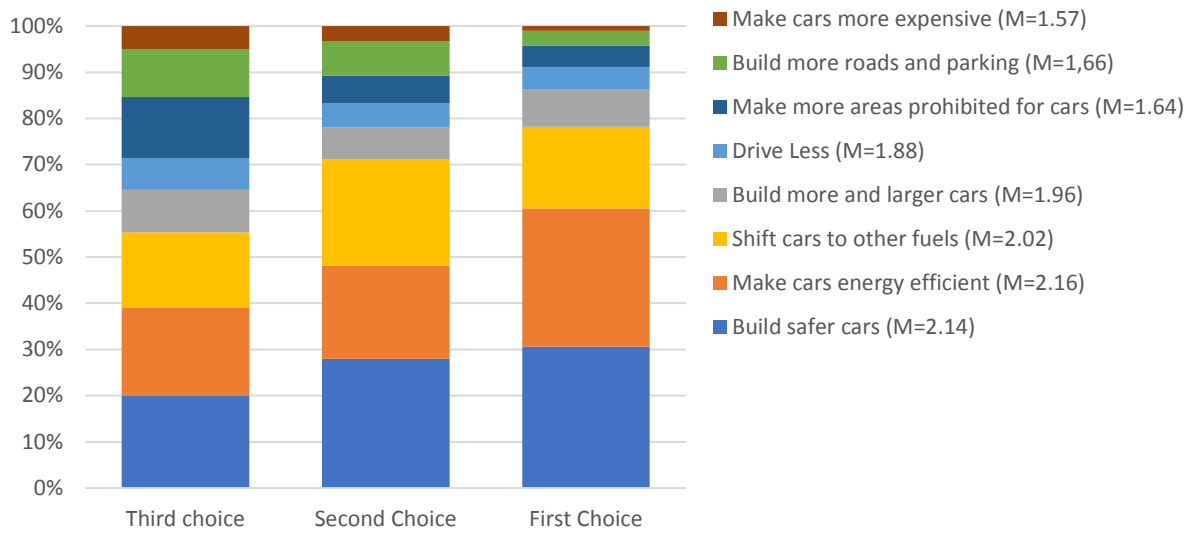
Source: Authors. Note: Figure shows the results as a percentage of all responses, although the mean score for each item is given in the legend.

Interestingly, the benefits of cars show more significant differences and greater spread in rankings across our sample than negative perceptions. Table 3 at glance shows that this results especially from different rankings in Denmark and the Netherlands for safety, speed and aesthetics; a difference further reinforced by different preferences among boys and girls for these same variables, and one that extends to significant differences on a more local level across schools – but less often across types of schools. This seems an indication that these differences are geographic in origin, not socio-economic. A Kruskal-Wallis test ($H(2) = 12.384$, $p = .002$) indicates that school size is significantly associated with preferences for speed, with medium sized schools ranking this higher than small schools and large schools. Likewise, children at small and large schools seem to deem safety more important than medium schools, with ($H(2) = 14.371$, $p = .001$)

5.4 Innovations in future mobility and transport

Lastly, our survey asked children about future innovations in mobility, and here their answers differ from preferences in the present: children overwhelmingly opt for safety and cars that are more environmentally friendly, as Figure 4 reveals. While a substantial section of pupils even rated "car free zones" as their third choice (n=78) and such zones score higher than additional roads or parking places, more stringent controls on cars were not favored: the least two preferred options were driving less and making cars more expensive. Also, while none of the questions dealt with automation and self-driving cars, the survey did ask for pupils to write in anything that was missing—and here, automated cars were never mentioned, because no students answered this element of the question.

Figure 4: Children's perceptions of future innovations in mobility (3-point scale)



Source: Authors. Note: Figure shows the results as a percentage of all responses, while the mean score for each item is given in the legend.

When we test the ranking of these variables, some variances return, both on count and mean rank. Dutch children rank energy efficiency higher than Danish children, while Danish children score higher on safer cars, environmental zones and a shifting to other fuels. When looking at gender, girls appear to

weigh safety and a reduction of car based transport (e.g. more public transport, car free zones) over the other options whereas boys focus more on the fuel component of cars. Age returns minimally with 13 year olds favoring energy efficiency measures (66.7% of them has this as a first choice versus around 30% for the 10-12 year old's and 7.1% of the 9 year old's). School size and school type return for efficiency with smaller schools and public schools preferring it more, while larger schools and charter schools score higher on bigger and safer cars – again indicative of socioeconomic and geographic differences.

6. Conclusion

In sum, our survey of hundreds of schoolchildren across Denmark and the Netherlands yields some pertinent findings for future energy and transport policy as well as research in environmental education and energy studies.

In the policy domain, our results suggest that efforts may bear more fruit when they are directed towards technical improvements to conventional and battery electric cars—fairly entrenched forms of automobilty—rather than drastically different forms such as cycling, walking, or mass transit. This is because more than half of the sample resided in two-car or three-car households, and a sobering 96.6% of children surveyed stated they want to own a personal car in the future. When asked to ponder precisely why they like cars, children mention safety, freedom, and status as recurring salient attributes. Although they were aware of disadvantages to cars such as danger (traffic accidents) and pollution (impacts to the environment), they seemed tolerate of them and while some suggested that the option of "car free zones" was tenable in the future, more restrictive options such as driving less or making cars more expensive (via taxes) were not favored.

In the environmental education and energy research domain, children however were able to demonstrate a robust and fairly remarkable knowledge about car brands (they identified more than thirty brands including popular ones such as Volkswagen or General Motors as well as rarer brands such as Tesla and Koenisgsegg). Children together have an aptitude for understanding how much money cars cost to own and drive. Surprisingly, most also properly estimate that the cost of a full battery electric vehicle is higher than an internal combustion engine vehicle; they correctly identify electric vehicles as better for the environment and quieter; and most had an understanding about comparative EV range and battery charging time.

In this way, children need not be necessarily treated as ignorant, or as empty vessels that need to be filled with knowledge about EVs. They already hold perceptions of EVs and cars that match factual performance across many dimensions. That said, and not surprising given this study's more rural focus, children seemed less aware about space and parking requirements—dimensions that future educators may want to target. In this way, our study can help inform the educational benefits of teaching children about sustainable mobility at school - assuming that they get no such signals form home or from peers – so that the future of cars need not look so very much like the past and present. Yet, it is an even stronger signal for policymakers and innovators wishing to displace the need for private car-based transport in geographies without public alternatives. Our study reconfirms the societal need to find better alternatives in these regions as well.

7. References

Addison, David, Malek Al-Chalabi, Cliff Elwell, Mark Evans, Neil Salmond, Rob Saunders, Open Roads, Anxious Drivers: A Technology and Policy Assessment for Long Range Electric Vehicles in the UK, Energy Policy Project, 2010.

Aguirre-Bielschowsky, Ikerne, Rob Lawson, Janet Stephenson, Sarah Todd, Kids and Kilowatts: Socialisation, energy efficiency, and electricity consumption in New Zealand, Energy Research & Social Science, Volume 44, 2018, Pages 178-18

Axsen, Jonn et al., Social influence and consumer preference formation for pro-environmental technology: The case of a U.K. workplace electric-vehicle study, Ecological Economics 95 (2013) 96–107

Axsen, J., Goldberg, S., Bailey, J. (2016) How might potential future plug-in electric vehicle buyers differ from current "Pioneer" owners? Transportation Research Part D: Transport and Environment 47, 357-370.

Axsen, Jonn, Brad Langman, Suzanne Goldberg, Confusion of innovations: Mainstream consumer perceptions and misperceptions of electric-drive vehicles and charging programs in Canada, Energy Research & Social Science, Volume 27, May 2017, Pages 163-173

Bailey, J., Axsen, J., 2015. Anticipating PEV buyers' acceptance of utility controlled charging. Transportation Research Part A: Policy and Practice 82, 29–46.

Balmford, Andrew, Lizzie Clegg, Tim Coulson, and Jennie Taylor, "Why Conservationists Should Heed Pokemon," Science 29 (295) (March, 2002), p. 2367.

Batterham, Debbie, Martin Stanisstreet & Edward Boyes (1996) Kids, cars and conservation: children's ideas about the environmental impact of motor vehicles, International Journal of Science Education, 18:3, 347-354

Bell, A. (2007). Designing and testing questionnaires for children. Journal of Research in Nursing, 12(5), 461–469. https://doi.org/10.1177/1744987107079616

Bergman, N, T Schwanen, and BK Sovacool. "Imagined People, Behavior, and Future Mobility: Insights from Visions of Electric Vehicles and Car Clubs in the United Kingdom," Transport Policy 59 (October, 2017), pp. 165-173.

Borg, F., Winberg, T. M., & Vinterek, M. (2017). Preschool children's knowledge about the environmental impact of various modes of transport. Early Child Development and Care, 0(0), 1–16. https://doi.org/10.1080/03004430.2017.1324433

Borgers, N., Hox, J., & Sikkel, D. (2003). Response Quality in Survey Research with Children and Adolescents: The Effect of Labeled Response Options and Vague Quantifiers. International Journal of Public Opinion Research, 15(1), 83–94. https://doi.org/https://doi.org/10.1093/ijpor/15.1.83

Boudet, Hilary, Nicole M. Ardoin, June Flora, K. Carrie Armel, Manisha Desai & Thomas N. Robinson. Effects of a behaviour change intervention for Girl Scouts on child and parent energy-saving behaviours Nature Energy 1, Article number: 16091 (2016)

Boyes, E., & Stanisstreet, M. (1997). The Environmental Impact of Cars: children's ideas and reasoning. Environmental Education Research, 3(3), 269–282.

Buekers, J., Van Holderbeke, M., Bierkens, J., Int Panis, L., 2014. Health and environmental benefits related to electric vehicle introduction in EU countries. Transportation Research Part D: Transport and Environment 33, 26–38.

Carley, S., R. M. Krause, et al. (2013). "Intent to purchase a plug-in electric vehicle: A survey of early impressions in large US cites." Transportation Research Part D: Transport and Environment 18: 39-45.

Carver, A., Timperio, A., Crawford, D. 2013. Parental chauffeurs: what drives their transport choice? Journal of Transport Geography 26, 72-77

Chawla, L., Cushing, D.F., 2007. Education for strategic behavior. Environmental Education Research 13 (4), 427–452.

Davison, P., Davison, P., Reed, N., Halden, D., & Dillon, J. (2003). Children's Attitudes to Sustainable Transport (Transport Research Series No. 174/2003). Scottish Executive Social Research.

Egbue, O. and S. Long (2012). "Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions." Energy Policy 48(2012): 717-729.

Egbue, O., Long, S., & Ng, E.-H. (2015). Charge It! Translating Electric Vehicle Research Results to Engage 7th and 8th Grade Girls. Journal of Science Education and Technology, 24(5), 663–670.

Ellingsen, L.A.-W., Singh, B., Strømman, A.H., 2016. The size and range effect: lifecycle greenhouse gas emissions of electric vehicles. Environ. Res. Lett. 11, 054010.

Fusco et al. 2012. Toward an understanding of children's perceptions of their transport geographies: (non)active school travel and visual representations of the built environment Journal of Transport Geography, Volume 20, Issue 1, Pages 62-70

Fylan, Fiona and Lauren Caveney, Young people's motivations to drive: expectations and realities. Transportation Research Part F: Traffic Psychology and Behaviour, Volume 52, 2018, pp. 32-39

Geels, Frank, Rene Kemp, Geoff Dudley, and Glenn Lyons, eds., Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport (London: Routledge, 2012)

Graham-Rowe, Ella. Benjamin Gardner, Charles Abraham, Stephen Skippon, Helga Dittmar, Rebecca Hutchins, Jenny Stannard, Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations, Transportation Research Part A: Policy and Practice, Volume 46, Issue 1, 2012, Pages 140-153

Greening LA, Greene DL, Difiglio C. 2000. Energy efficiency and consumption—the rebound effect—A Survey. Energy Policy 28(6/7): 389–401.

Hamamoto, Mitsutsugu. An empirical study on the behavior of hybrid-electric vehicle purchasers, Energy Policy, Volume 125, 2019, Pages 286-292

Helbich, M et al 2016. Natural and built environmental exposures on children's active school travel: A Dutch global positioning system-based cross-sectional study. Health & Place, Volume 39, Pages 101-109.

Intergovernmental Panel on Climate Change. "Summary for Policymakers,'' Climate Change: 2014 (Geneva, UNFCCC: 2014).

International Energy Agency. 2010. Energy Technology Perspectives: Scenarios and Strategies to 2050 (Paris: International Energy Agency), http://www.iea.org/techno/etp/etp10/English.pdf.

International Energy Agency, Global EV Outlook 2016 (Paris: OECD, 2016).

Isenhour, Cindy. 2010. On conflicted Swedish consumers, the effort to stop shopping and neoliberal environmental governance. Journal of Consumer Behavior, Volume 9, Issue 6, November/December 2010, Pages 454-469

Kaplan, S., Nielsen, T. A. S., & Prato, C. G. (2016). Walking, cycling and the urban form: A Heckman selection model of active travel mode and distance by young adolescents. Transportation Research Part D: Transport and Environment, 44, 55–65

Kester, J, L Noel, G Zarazua de Rubens, and BK Sovacool. "Policy Mechanisms to Accelerate Electric Vehicle Adoption: A Qualitative Review from the Nordic Region," Renewable & Sustainable Energy Reviews 94 (October, 2018), pp. 719-731.

Konrad, Kathrin and Dirk Wittowsky, Virtual mobility and travel behavior of young people – Connections of two dimensions of mobility, Research in Transportation Economics, Volume 68, 2018, pp. 11-17

Kopnina, Helen. 2011. Kids and cars: Environmental attitudes in children Transport Policy, Volume 18, Issue 4, 2011, pp. 573-578

Kopnina, Helen, Melanie Williams, Car attitudes in children from different socio-economic backgrounds in the Netherlands, Transport Policy, Volume 24, 2012, Pages 118-125.

Korhonen, K., Lappalainen, A., 2004. Examining awareness of children and adolescent in the Ramomafana region, Madagascar. Environmental Education Research 10 (2), 195–216.

Kuhnimhof, Tobias, Ralph Buehler, Matthias Wirtz, Dominika Kalinowska, Travel trends among young adults in Germany: increasing multimodality and declining car use for men, Journal of Transport Geography, Volume 24, 2012, pp. 443-450

Langbroek, Joram H.M., Joel P. Franklin, Yusak O. Susilo, How would you change your travel patterns if you used an electric vehicle? A stated adaptation approach, Travel Behaviour and Society, Volume 13, 2018, Pages 144-154

Leeson, E., Stanisstreet, M., & Boyes, E. (1997a). Primary children's ideas about cars and the environment. Education 3-13, 25(2), 25–29.

Leeson, E., Stanisstreet, M., & Boyes, E. (1997b). Children's ideas about the environmental impact of cars: a cross age study. International Journal of Environmental Studies, 52(1–4), 89–103.

Line, Tilly et al 2012. Applying behavioural theories to studying the influence of climate change on young people's future travel intentions. Transportation Research Part D 17 270–276.

Line, Tilly et al 2010. The travel behaviour intentions of young people in the context of climate change. Journal of Transport Geography 18 238–246.

Liu, J et al 2015 - Driving pattern analysis of Nordic region based on National Travel Surveys for electric vehicle integration. J. Mod. Power Syst. Clean Energy (2015) 3(2):180–189

McDonald, N. 2007. Active transportation to school: Trends among U.S. schoolchildren, 1969-2001. American Journal of Preventive Medicine 32(6), 509-516.

Mitchell, William J. and Christopher E. Borroni-Bird, and Lawrence D. Burns, Reinventing the Automobile Personal Urban Mobility for the 21st Century (Cambridge, MA: MIT Press, 2010).

Musser, L.M., Diamond, K.E., 1999. The children's attitudes toward the environment scale. Journal of Environmental Education 30 (2), 23–30.

National Center for Environmental Assessment, Provisional Assessment of Recent Studies of Health Effects of Particulate Matter Exposure (Washington, DC: U.S. Environmental Protection Agency, July 2006, EPA/600/R-06/063).

Nillson, M., Kuller, R., 2000. Travel behavior and environmental concern. Transportation Research Part D: Transport and Environment 5 (3), 211–234.

Nye, David E. Consuming Power: A Social History of American Energies. Cambridge, MA: MIT Press, 1999.

Pope, Carl, Majid Ezzati, and Douglas W. Dockery, "Fine-Particulate Air Pollution and Life Expectancy in the United States," *New England Journal of Medicine* 360(4) (2009), pp. 376-386

Ryghaug, Marianne and Marit Toftaker, A Transformative Practice? Meaning, Competence, and Material Aspects of Driving Electric Cars in Norway, Nature and Culture 9(2), Summer 2014: 146–163

Scheiner et al 2019. Children's mode choice for trips to primary school: a case study in German suburbia. Travel Behaviour and Society, Volume 15, April 2019, Pages 15-27

Schneidereit, Tina, Thomas Franke, Madlen Günther, Josef F. Krems, Does range matter? Exploring perceptions of electric vehicles with and without a range extender among potential early adopters in Germany, Energy Research & Social Science, Volume 8, July 2015, Pages 198-206

Seebauer, Sebastian. The psychology of rebound effects: Explaining energy efficiency rebound behaviours with electric vehicles and building insulation in Austria, Energy Research & Social Science, Volume 46, December 2018, Pages 311-320

She, Zhen-Yu et al. What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China. Transport Policy 56 (2017) 29–40

Sigurdardottir, Sigrun Birna, Sigal Kaplan, Mette Møller, Thomas William Teasdale, Understanding adolescents' intentions to commute by car or bicycle as adults, Transportation Research Part D: Transport and Environment, Volume 24, 2013, pp. 1-9

Sigurdardottir, S. B., Kaplan, S., & Møller, M. (2014). The motivation underlying adolescents′ intended time-frame for driving licensure and car ownership: A socio-ecological approach. Transport Policy, 36, 19–25.

Sovacool, BK. "Experts, theories, and electric mobility transitions: Toward an integrated conceptual framework for the adoption of electric vehicles," Energy Research & Social Science 27 (May, 2017), pp. 78-95.

Sovacool, BK and PL Blyth. "Energy and Environmental Attitudes in the Green State of Denmark: Implications for Energy Democracy, Low Carbon Transitions, and Energy Literacy," Environmental Science & Policy 54 (December, 2015), pp. 304-315.

Stone, M., Larsen, K., Faulkner, G., Buliung, R., Arbour-Nicitopoulos, K., Lay, J. 2014. Predictors of driving among families living within 2km from school: Exploring the role of the built environment. Transport Policy 33, 8-16.

Tran, Martino et al., Realizing the electric-vehicle revolution, Nature Climate Change 2, 328–333 (2012)

Urry, John. The system of automobility. Theory, Culture & Society, Vol 21, Issue 4-5, 2004.

Wells, N.M., Lekies., K.S., 2006. Nature and the life course: pathways from childhood nature experiences to adult environmentalism. Children, Youth and Environments 16 (1), 1–24.